

A close-up photograph of an astronaut's helmet and white spacesuit. The helmet's visor reflects the complex structure of the International Space Station and the Earth's horizon. A bright sun is visible in the upper left corner, creating a starburst effect. The text "Protecting Access to Space" is overlaid in large white font.

# Protecting Access to Space

Presentation to Senior Leaders

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# Protecting Access to Space

- The problem
- A framework for protecting access
- Findings
- Way ahead





# The Space Problem

- We are all dependent on space in ways that are not obvious
- Space is vulnerable in ways that require us to be proactive in order to protect it



# Space Dependencies

Mineral & Oil detection  
Agricultural compliance  
Consequence management  
Security in remote districts  
Ship status during search & rescue  
Facilities emplacement  
Ice flow monitoring  
Tele-medicine

Weather forecasting  
Agricultural efficiency  
Timing & synchronization  
Air traffic control  
Disaster relief planning  
Asset/fleet tracking  
Missile launch detection  
Power grid coordination

Precision guided munitions  
Border monitoring  
Unmanned aerial vehicle operations  
Mapping  
Satellite radio  
Arms control verification  
Rural telephony  
Missile defence command & control  
TV signal distribution  
Broadband internet  
Reachback

Obscure

Obvious



# Space Environment is Vulnerable



- Persistence
- Congested
  - Finite useful orbits contain important spacecraft
- Fragile
  - “Collisional Cascade”
- Limited ability to ‘self-heal’

# Threats to Space Capabilities



- Anti-Satellite Missile
- Conventional attack (Against enabling infrastructure)
- Cyber
- Electro-Magnetic Pulse (High Altitude Nuclear Explosion)
- Electronic Warfare (including Jamming / Spoofing)
- Laser (High or low-powered)
- Physical Interference



# The Space Problem: Summary



Dependencies greater than military-usage

- Significant economic & societal consequences

Access to space at risk

- Current approach unsustainable
- Broad range of threats & actors

**Vulnerability Gap**

Need to act proactively

- Managing consequences not always an option



# Solving the Problem: MNE7 Scope

## In

- Space Situational Awareness
  - Assume sufficient
- Debris
  - Deliberate events
- Capability Elements

## Out

- Space Situational Awareness
  - Improvements
- Debris
  - Management
- Capability Elements

Space ✓ Element



Communications ✗ Element



Ground ✗ Elements

# Solving the Problem: MNE7 Scope

## In

- Space Situational Awareness
  - Assume sufficient
- Debris
  - Deliberate events
- Capability Elements
  - Space
- Actors
  - States
- Situations
  - Not at war

## Out

- Space Situational Awareness
  - Improvements
- Debris
  - Management
- Capability Elements
  - Communication, Ground
- Actors
  - Non-State, Individuals
- Situations
  - War



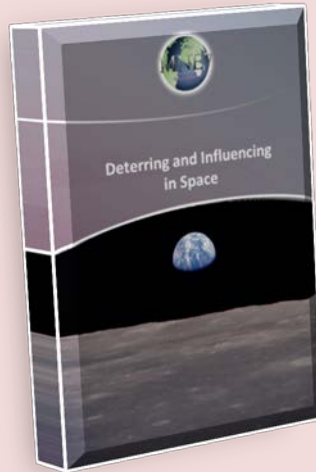
Identify  
**dependencies** on,  
**threats** to, and  
**vulnerabilities** of  
space capabilities

“Space Handbook”



Identify  
mechanisms to  
**deter, coerce, or**  
**influence** actors in  
space

Detering & Influencing  
in Space Process



Develop proposals  
for **mitigation** if  
deterrence fails

Collaborative  
Mitigation Concept



Framework to  
**Protect Access** to  
Space

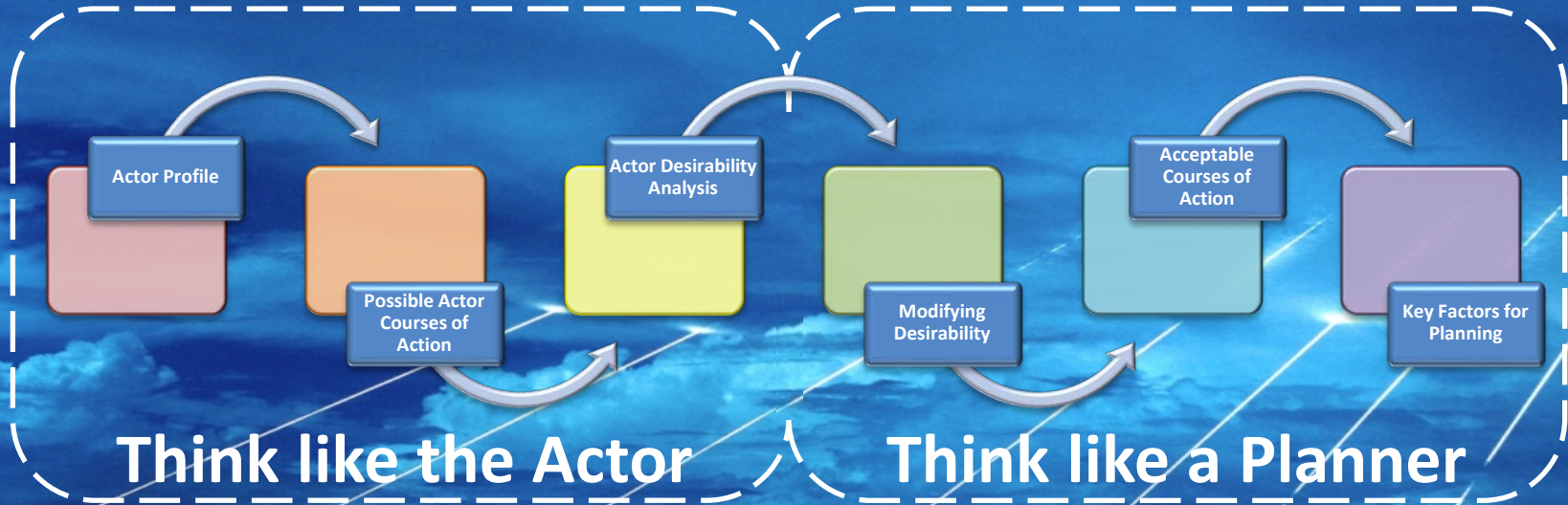
Protecting Access  
to Space



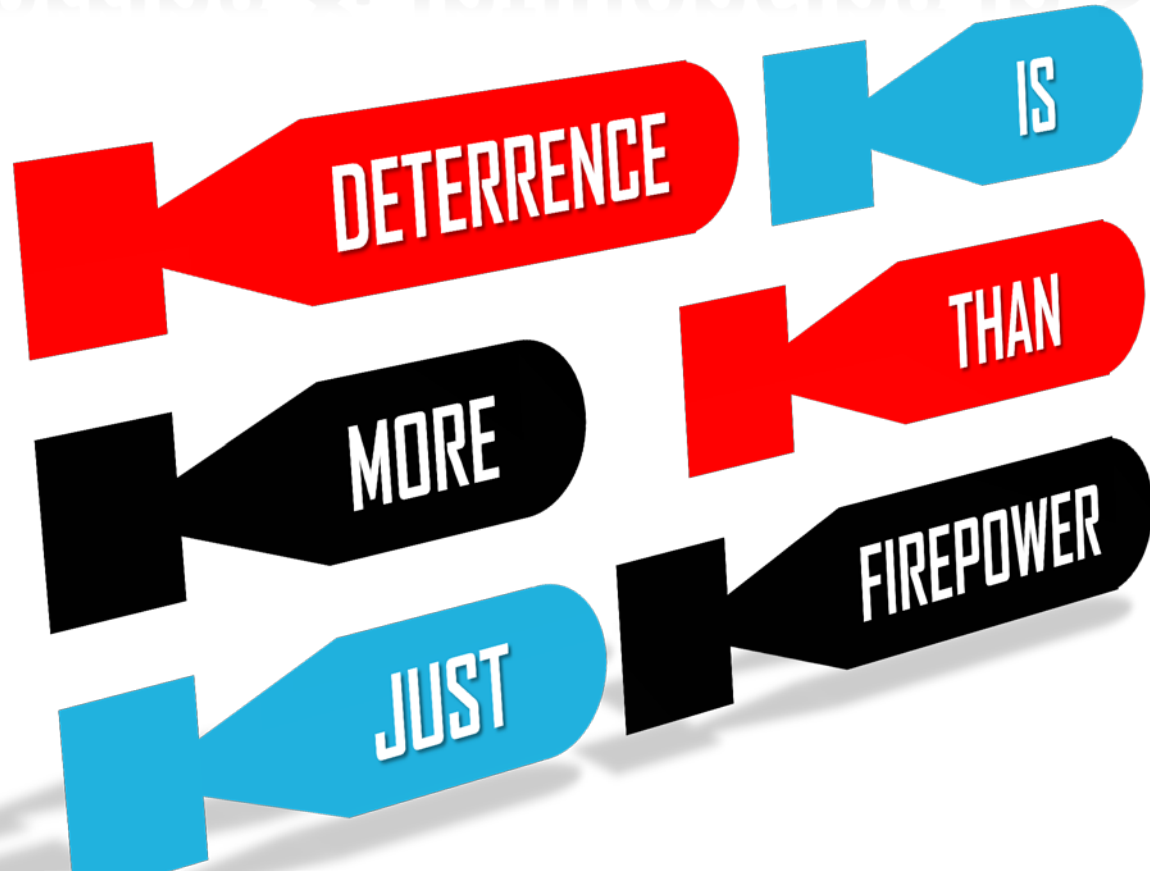
# National Dependencies

- Critical national infrastructure sectors used
  - identifies essential national services
- Considers:
  - Time-to-failure
  - Effectiveness of backup services
  - Importance of space to activity
- An assessment is conducted to determine specific vulnerabilities
  - Relative importance
  - Targets finite resources
  - National business continuity

# Detering & Influencing in Space



# Detering & Influencing in Space







# Space Defensive Measures

Provide a certain level of protection.

Defensive measures depend on the design phase.


Each kilogram dedicated to protect a satellite cannot be dedicated to the payload.

Protection increases costs



Irreversible compromise between performance and protection early in the capability development process.

# Space Defensive Measures

- 
- Frequency Deconfliction
  - Manoeuvre
  - Suspend Operations
  - Autonomous Operations
  - Encryption
  - Physical Shielding
  - Radiation Hardening
  - Shutter / Filters



Reduced performance  
and/or lifetime  
(+ requires appropriate SSA)



# Collaborative Space Mitigation

*Managing the risk  
of disruption or denial effects on space capabilities.*

## Assumptions:

- Latent space capacity exists
- Partnership opportunities exist to leverage latent capacity
  - Affordable & sustainable



# Collaborative Space Mitigation

Concept: 5 step process

Operational requirements



Impacted functionalities



Partnership opportunities



Defining the integration framework



Implementing the integration framework 20



# Collaborative Space Mitigation

- Performance and affordability as expected;
- Interoperability comes at a cost;
- Political acceptability is critical.

# Conclusions



# Summary of Findings

Vulnerability gap requires a proactive & collaborative approach

Space is everybody's business

- Anticipate & manage risks before they arise
- Prepare for the consequences
- Almost all nations, space faring or not, depend on space
- Responsibilities beyond narrow cadre of space professionals



# Summary of Findings (Ctd)

Assuming latent space capacity exists

Space Defence is presently a national matter with a very high level of sensitivity

- Leveraging it through partnerships depends on willingness to collaborate, political acceptability, cost of interoperability
- Opportunities to share best practises in the framework of specific partnerships

# Way ahead

Current approach **unsustainable**, thus the need to:

- **Change perceptions**

- We are all dependent
- Responsibilities for protection beyond space professionals

- Anticipate & manage risks **before they arise**

- Identify dependencies
- Manage behaviour

- **Prevent escalation**

- Avoid reciprocal strategies in space

- Prepare for the **consequences**

- ...in the event other efforts fail
- 'Preparedness'

***Space Handbook &  
Protecting Space Guide***



***Critical Dependencies Concept***



***Process on Managing  
Behaviour in Space***



***Concept on Mitigation***



# Way ahead (Ctd)

## Handbook

NATO: Space course

CAN: Education of senior leaders

## Process

National and multinational  
crisis management process

## Guide & Supporting documents

NATO: work on space dependencies and  
mitigation options (NBi-SCSWG)

CAN: national capability development

CHE: domestic security and debris management (UN)







END

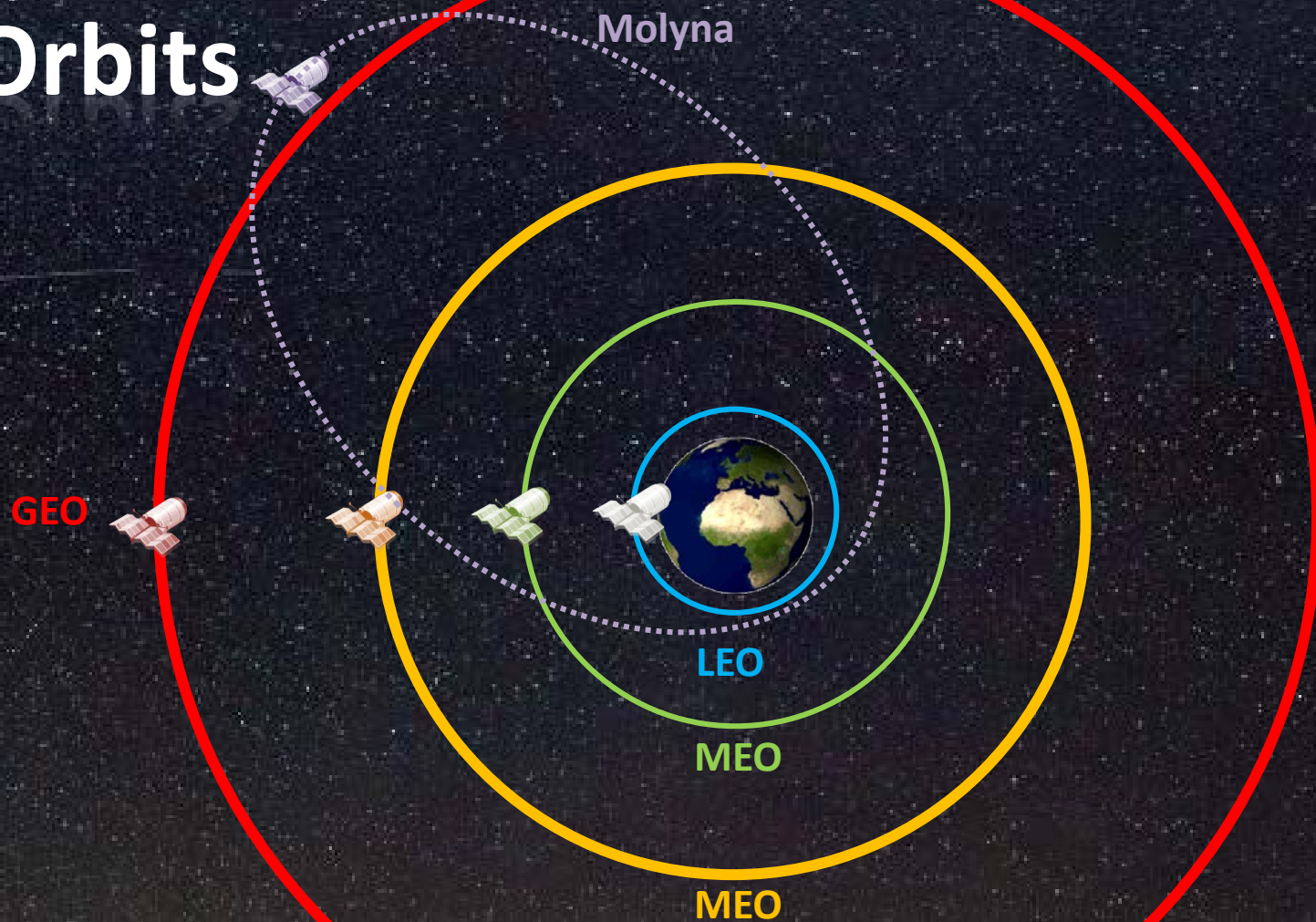
# Back Up Slides

# The Space Pillars

- **Position, Navigation, & Timing [MEO]**
  - Allows user to determine position, time, or velocity
- **Satellite Communications [GEO, LEO]**
  - Beyond line-of-sight communications
  - Higher quality & capacity than alternatives
- **Intelligence, Surveillance, & Reconnaissance [LEO, GEO]**
  - Unrestricted global access to overhead observation
  - Broad applications, civil & military
- **Space Situation Awareness**
  - Comprehensive understanding of environment, including object tracking and space weather
  - Important for successful delivery of other pillars



# Orbits



# Dependency Case Studies

- Agriculture
  - Guides farm machinery
  - Weather forecasting
- Resource Prospecting
  - Mapping & detection of resources
  - Environmental monitoring
- Air Delivered Weapons
  - Requirements to avoid collateral damage oblige the use of precision munitions
- Missile Defence
  - Missile launch detection
  - Command & control

# Space Law

- Outer Space Treaty ('67) & supporting regulations
  - Weapons of mass destruction: No WMD in orbit
  - Military bases, testing weapons, or conducting military manoeuvres on the Moon or other celestial bodies not allowed
  - Sovereignty. Launching nation maintains jurisdiction over manned spacecraft, satellites property of owner
  - Peaceful use
- But no agreed definition for where space 'starts'
  - Therefore no consensus whether spacecraft orbit in national airspace
  - E.g. Bogota declaration



# Space Deterrence LOE

- Tested practicability & utility of the process
- One-sided open wargame
  - CDAG method
- 17 Participants + Experiment Team
  - 9 Nations, + EU EAS, UNIDIR
- Six vignettes examined
  - 87 Actor Courses of Action developed
- Experiment reporting via CDEMS

# Space Mitigation LOE

- Examined political acceptability
  - Partner: types & capability level; Sharing: provisions & caveats; Compensation
- Two methods
  - Tabletop + Decision-support software (Swiss "CREDO")
- 7 Participants + Experiment Team
  - Canada, Germany, NATO, USA
- Examined 3 vignettes
  - ISR, SATCOM, SSA
- DRDC Technical Memorandum forthcoming